N *National Semiconductor*

54AC151 • 54ACT151
# 8-Input Multiplexer

General Description

The 'AC/'ACT151 is a high-speed 8-input digital multiplexer. It provides, in one package, the ability to select one line of data from up to eight sources. The 'AC/'ACT151 can be used as a universal function generator to generate any logic function of four variables. Both true and complementary outputs are provided.

Features

■ I_{CC} reduced by 50%
■ Outputs source/sink 24 mA
■ 'ACT151 has TTL-compatible inputs
■ Standard Microcircuit Drawing (SMD)
   — 'AC151: 5962-87691
   — 'ACT151: 5962-88756

Ordering Code:

Logic Symbols

DS100270-1

IEEE/IEC

DS100270-6
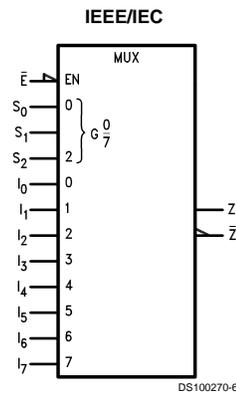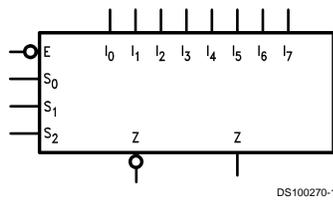
Pin Names	Description
I_0–I_7	Data Inputs
S_0–S_2	Select Inputs
$\overline{E}$	Enable Input
Z	Data Output
$\overline{Z}$	Inverted Data Output

FACT® is a registered trademark of Fairchild Semiconductor Corporation.

Connection Diagrams

DS100270-2

DS100270-3
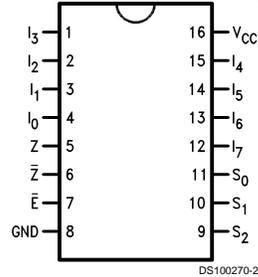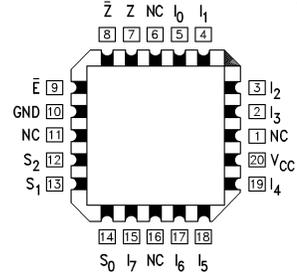
Truth Table

Inputs				Outputs	
$\overline{E}$	S_2	S_1	S_0	$\overline{Z}$	Z
H	X	X	X	H	L
L	L	L	L	$\overline{I}_0$	I_0
L	L	L	H	$\overline{I}_1$	I_1
L	L	H	L	$\overline{I}_2$	I_2
L	L	H	H	$\overline{I}_3$	I_3
L	H	L	L	$\overline{I}_4$	I_4
L	H	L	H	$\overline{I}_5$	I_5
L	H	H	L	$\overline{I}_6$	I_6
L	H	H	H	$\overline{I}_7$	I_7

H = HIGH Voltage Level
L = LOW Voltage Level
X = Immaterial

Functional Description

The 'AC/'ACT151 is a logic implementation of a single pole, 8-position switch with the switch position controlled by the state of three Select inputs, S_0, S_1, S_2. Both true and complementary outputs are provided. The Enable input ($\overline{E}$) is active LOW. When it is not activated, the complementary output is HIGH and the true output is LOW regardless of all other inputs. The logic function provided at the output is:

$$Z = \overline{E} \bullet (I_0 \bullet \overline{S}_0 \bullet \overline{S}_1 \bullet \overline{S}_2 + I_1 \bullet S_0 \bullet \overline{S}_1 \bullet \overline{S}_2 +$$
$$I_2 \bullet \overline{S}_0 \bullet S_1 \bullet \overline{S}_2 + I_3 \bullet S_0 \bullet S_1 \bullet \overline{S}_2 + I_4 \bullet \overline{S}_0 \bullet \overline{S}_1 \bullet S_2 +$$
$$I_5 \bullet S_0 \bullet \overline{S}_1 \bullet \overline{S}_2 + I_6 \bullet \overline{S}_0 \bullet S_1 \bullet S_2 + I_7 \bullet S_0 \bullet S_1 \bullet S_2)$$

The 'AC/'ACT151 provides the ability, in one package to select from eight sources of data or control information. By proper manipulation of the inputs, the 'AC/'ACT151 can provide any logic function of four variables and its complement.

Logic Diagram
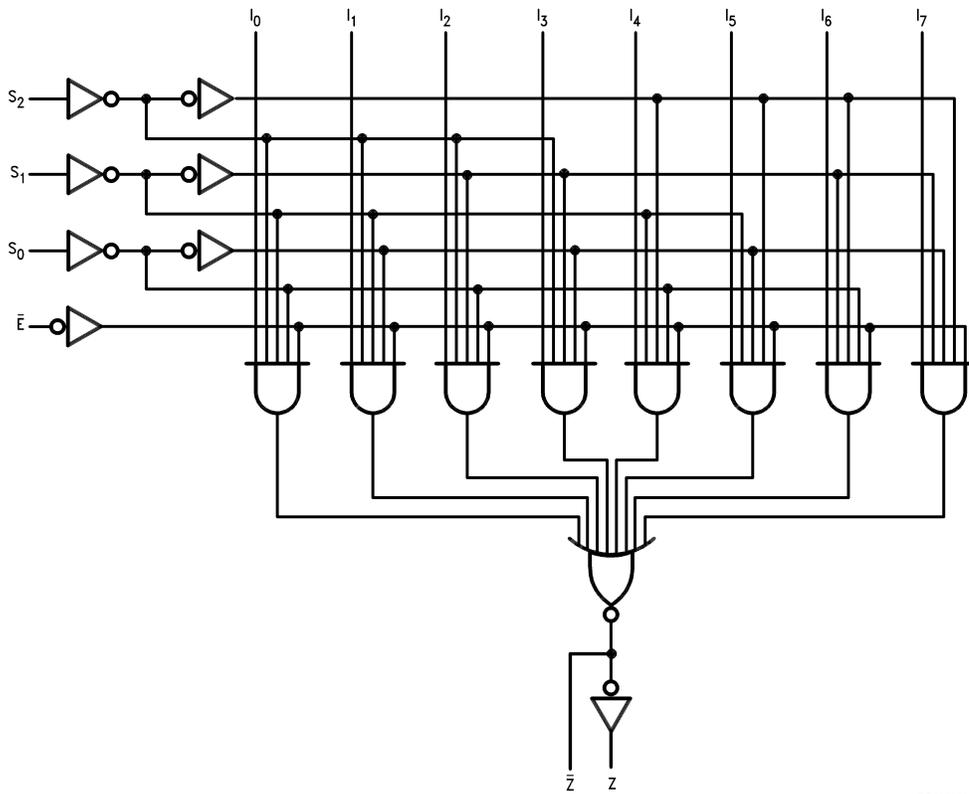
DS100270-4

Please note that this diagram is provided only for the understanding of logic operations and should not be used to estimate propagation delays.

Absolute Maximum Ratings (Note 1)

If Military/Aerospace specified devices are required, please contact the National Semiconductor Sales Office/ Distributors for availability and specifications.

Supply Voltage (V_{CC})	−0.5V to +7.0V
DC Input Diode Current (I_{IK})	
V_I = −0.5V	−20 mA
V_I = V_{CC} + 0.5V	+20 mA
DC Input Voltage (V_I)	−0.5V to V_{CC} + 0.5V
DC Output Diode Current (I_{OK})	
V_O = −0.5V	−20 mA
V_O = V_{CC} + 0.5V	+20 mA
DC Output Voltage (V_O)	−0.5V to V_{CC} + 0.5V
DC Output Source or Sink Current (I_O)	±50 mA
DC V_{CC} or Ground Current per Output Pin (I_{CC} or I_{GND})	±50 mA
Storage Temperature (T_{STG})	−65°C to +150°C
Junction Temperature (T_J)	
CDIP	175°C

Recommended Operating Conditions

Supply Voltage (V_{CC})	
'AC	2.0V to 6.0V
'ACT	4.5V to 5.5V
Input Voltage (V_I)	0V to V_{CC}
Output Voltage (V_O)	0V to V_{CC}
Operating Temperature (T_A)	
54AC/ACT	−55°C to +125°C
Minimum Input Edge Rate ($\Delta V/\Delta t$)	
'AC Devices	
V_{IN} from 30% to 70% of V_{CC}	
V_{CC} @ 3.3V, 4.5V, 5.5V	125 mV/ns
Minimum Input Edge Rate ($\Delta V/\Delta t$)	
'ACT Devices	
V_{IN} from 0.8V to 2.0V	
V_{CC} @ 4.5V, 5.5V	125 mV/ns

Note 1: Absolute maximum ratings are those values beyond which damage to the device may occur. The databook specifications should be met, without exception, to ensure that the system design is reliable over its power supply, temperature, and output/input loading variables. National does not recommend operation of FACT® circuits outside databook specifications.

DC Characteristics for 'AC Family Devices

Symbol	Parameter	V_{CC} (V)	54AC T_A = −55°C to +125°C Guaranteed Limits	Units	Conditions
V_{IH}	Minimum High Level Input Voltage	3.0	2.1	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
		4.5	3.15		
		5.5	3.85		
V_{IL}	Maximum Low Level Input Voltage	3.0	0.9	V	V_{OUT} = 0.1V or V_{CC} − 0.1V
		4.5	1.35		
		5.5	1.65		
V_{OH}	Minimum High Level Output Voltage	3.0	2.9	V	I_{OUT} = −50 µA
		4.5	4.4		
		5.5	5.4		
		3.0	2.4	V	(Note 2) V_{IN} = V_{IL} or V_{IH} I_{OH} = −12 mA
		4.5	3.7		I_{OH} = −24 mA
		5.5	4.7		I_{OH} = −24 mA
V_{OL}	Maximum Low Level Output Voltage	3.0	0.1	V	I_{OUT} = 50 µA
		4.5	0.1		
		5.5	0.1		
		3.0	0.50	V	(Note 2) V_{IN} = V_{IL} or V_{IH} I_{OL} = 12 mA
		4.5	0.50		I_{OL} = 24 mA
		5.5	0.50		I_{OL} = 24 mA
I_{IN}	Maximum Input Leakage Current	5.5	±1.0	µA	V_I = V_{CC}, GND
I_{OLD}	Minimum Dynamic Output Current (Note 3)	5.5	50	mA	V_{OLD} = 1.65V Max
I_{OHD}		5.5	−50	mA	V_{OHD} = 3.85V Min

DC Characteristics for 'AC Family Devices (Continued)

Symbol	Parameter	V_{CC} (V)	54AC $T_A = -55°C$ to $+125°C$ Guaranteed Limits	Units	Conditions
I_{CC}	Maximum Quiescent Supply Current	5.5	80.0	µA	$V_{IN} = V_{CC}$ or GND

Note 2: All outputs loaded; thresholds on input associated with output under test.

Note 3: Maximum test duration 2.0 ms, one output loaded at a time.

Note 4: I_{IN} and I_{CC} @ 3.0V are guaranteed to be less than or equal to the respective limit @ 5.5V V_{CC}.

I_{CC} for 54AC @ 25°C is identical to 74AC @ 25°C

DC Characteristics for 'ACT Family Devices

Symbol	Parameter	V_{CC} (V)	54ACT $T_A = -55°C$ to $+125°C$ Guaranteed Limits	Units	Conditions
V_{IH}	Minimum High Level Input Voltage	4.5	2.0	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		5.5	2.0		
V_{IL}	Maximum Low Level Input Voltage	4.5	0.8	V	$V_{OUT} = 0.1V$ or $V_{CC} - 0.1V$
		5.5	0.8		
V_{OH}	Minimum High Level Output Voltage	4.5	4.4	V	$I_{OUT} = -50$ µA
		5.5	5.4		
		4.5	3.70	V	(Note 5) $V_{IN} = V_{IL}$ or V_{IH} $I_{OH} = -24$ mA
		5.5	4.70		$I_{OH} = -24$ mA
V_{OL}	Maximum Low Level Output Voltage	4.5	0.1	V	$I_{OUT} = 50$ µA
		5.5	0.1		
		4.5	0.50	V	(Note 5) $V_{IN} = V_{IL}$ or V_{IH} $I_{OL} = 24$ mA
		5.5	0.50		$I_{OL} = 24$ mA
I_{IN}	Maximum Input Leakage Current	5.5	±1.0	µA	$V_I = V_{CC}$, GND
I_{CCT}	Maximum I_{CC}/Input	5.5	1.6	mA	$V_I = V_{CC} - 2.1V$
I_{OLD}	Minimum Dynamic	5.5	50	mA	$V_{OLD} = 1.65V$ Max
I_{OHD}	Output Current (Note 6)	5.5	-50	mA	$V_{OHD} = 3.85V$ Min
I_{CC}	Maximum Quiescent Supply Current	5.5	80.0	µA	$V_{IN} = V_{CC}$ or GND

Note 5: All outputs loaded; thresholds on input associated with output under test.

Note 6: Maximum test duration 2.0 ms, one output loaded at a time.

Note 7: I_{CC} for 54ACT @ 25°C is identical to 74ACT @ 25°C.

AC Electrical Characteristics

Symbol	Parameter	V_{CC} (V) (Note 8)	54AC $T_A = -55°C$ to $+125°C$ $C_L = 50$ pF		Units	Fig. No.
			Min	Max		
t_{PLH}	Propagation Delay S_n to Z or $\overline{Z}$	3.3	1.0	22.0	ns	
		5.0	1.0	15.5		

AC Electrical Characteristics (Continued)

Symbol	Parameter	V_CC (V) (Note 8)	54AC T_A = −55°C to +125°C C_L = 50 pF		Units	Fig. No.
			Min	Max		
t_{PHL}	Propagation Delay S_n to Z or $\overline{Z}$	3.3	1.0	22.0	ns	
		5.0	1.0	15.5		
t_{PLH}	Propagation Delay $\overline{E}$ to Z or $\overline{Z}$	3.3	1.0	15.5	ns	
		5.0	1.0	12.0		
t_{PHL}	Propagation Delay $\overline{E}$ to Z or $\overline{Z}$	3.3	1.0	15.5	ns	
		5.0	1.0	12.0		
t_{PLH}	Propagation Delay I_n to Z or $\overline{Z}$	3.3	1.0	16.0	ns	
		5.0	1.0	12.0		
t_{PHL}	Propagation Delay I_n to Z or $\overline{Z}$	3.3	1.0	18.0	ns	
		5.0	1.0	13.0		

Note 8: Voltage Range 3.3 is 3.3V ±0.3V

Voltage Range 5.0 is 5.0V ±0.5V

AC Electrical Characteristics

Symbol	Parameter	V_CC (V) (Note 9)	54ACT T_A = −55°C to +125°C C_L = 50 pF		Units	Fig. No.
			Min	Max		
t_{PLH}	Propagation Delay S_n to Z	5.0	1.0	19.5	ns	
t_{PHL}	Propagation Delay S_n to Z	5.0	1.0	20.0	ns	
t_{PLH}	Propagation Delay S_n to $\overline{Z}$	5.0	1.0	19.5	ns	
t_{PHL}	Propagation Delay S_n to $\overline{Z}$	5.0	1.0	20.0	ns	
t_{PLH}	Propagation Delay $\overline{E}$ to Z	5.0	1.0	12.0	ns	
t_{PHL}	Propagation Delay $\overline{E}$ to Z	5.0	1.0	12.5	ns	
t_{PLH}	Propagation Delay $\overline{E}$ to $\overline{Z}$	5.0	1.0	12.0	ns	
t_{PHL}	Propagation Delay $\overline{E}$ to $\overline{Z}$	5.0	1.0	12.5	ns	
t_{PLH}	Propagation Delay I_n to Z	5.0	1.0	15.0	ns	
t_{PHL}	Propagation Delay I_n to Z	5.0	1.0	16.0	ns	
t_{PLH}	Propagation Delay I_n to $\overline{Z}$	5.0	1.0	15.0	ns	
t_{PHL}	Propagation Delay I_n to $\overline{Z}$	5.0	1.0	16.0	ns	

Note 9: Voltage Range 5.0 is 5.0V ±0.5V

Capacitance

Symbol	Parameter	Typ	Units	Conditions
C_{IN}	Input Capacitance	4.5	pF	V_{CC} = OPEN
C_{PD}	Power Dissipation Capacitance	70.0	pF	V_{CC} = 5.0V

Physical Dimensions inches (millimeters) unless otherwise noted

Top View

0.350 ± 0.008
(8.890 ± 0.203)

Side View

0.063 − 0.075
(1.600 − 1.905)

DETAIL A

Bottom View

0.200 ± 0.005
(5.080 ± 0.127)
TYP

45° × 0.015 ± 0.010
(0.381 ± 0.254)

0.015
(0.381)
MIN TYP

0.007 − 0.011
(0.178 − 0.279)
R TYP

0.022 − 0.028
(0.559 − 0.711)
TYP

0.077 − 0.093
(1.959 − 2.362)

PIN #1
INDEX

0.045 − 0.055
(1.143 − 1.397)
TYP

0.067 − 0.083
(1.702 − 2.108)
TYP

0.045 − 0.055
(1.143 − 1.397)
TYP

45° × 0.040 ± 0.010
(1.016 ± 0.254)
3 PLCS

Detail A

0.003
(0.076)
MIN TYP

0.015
(0.381)
MAX TYP

0.022
(0.559)
MAX TYP

0.006
(0.152)
MIN TYP
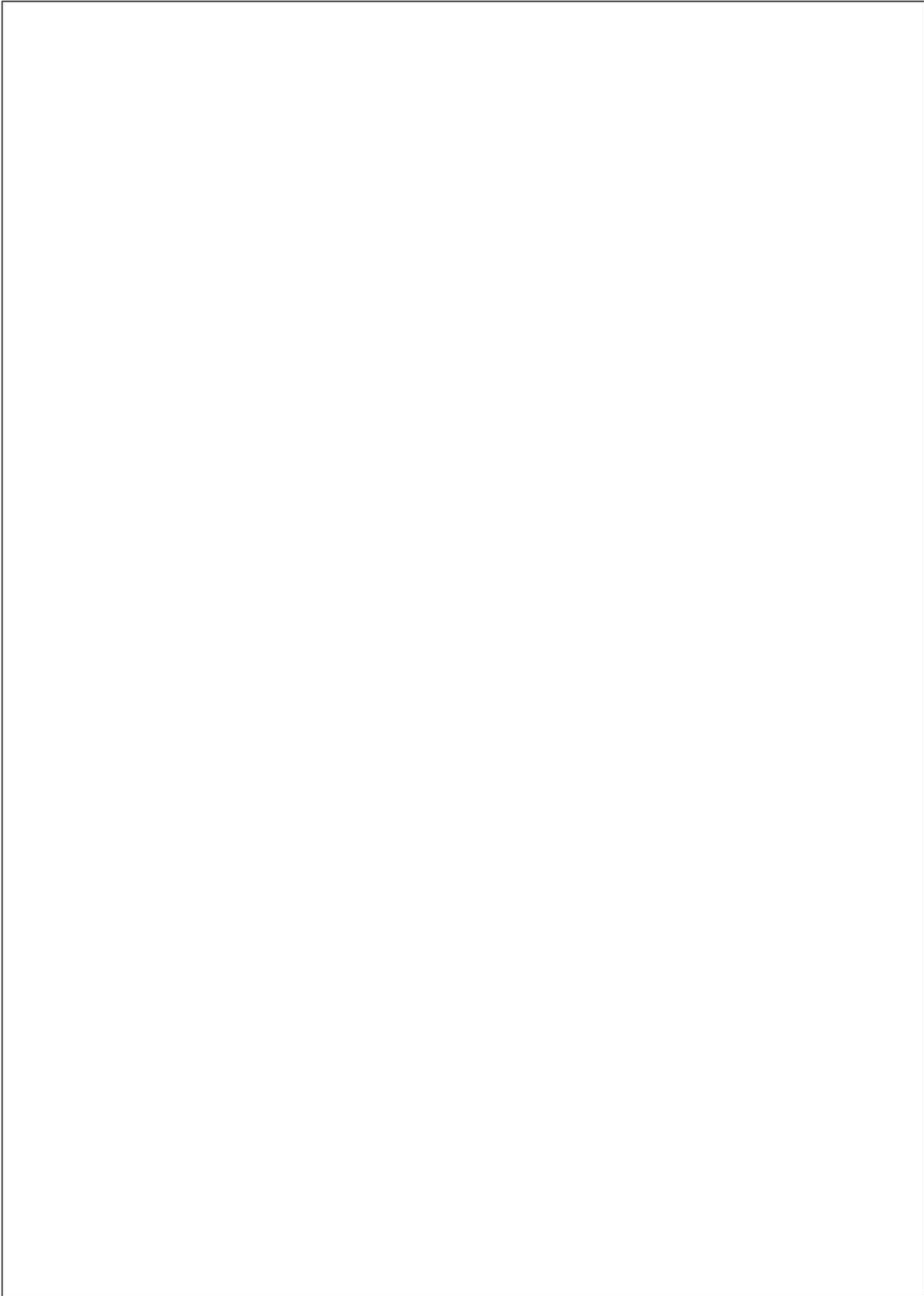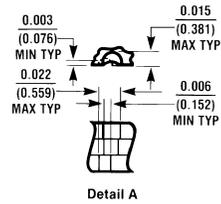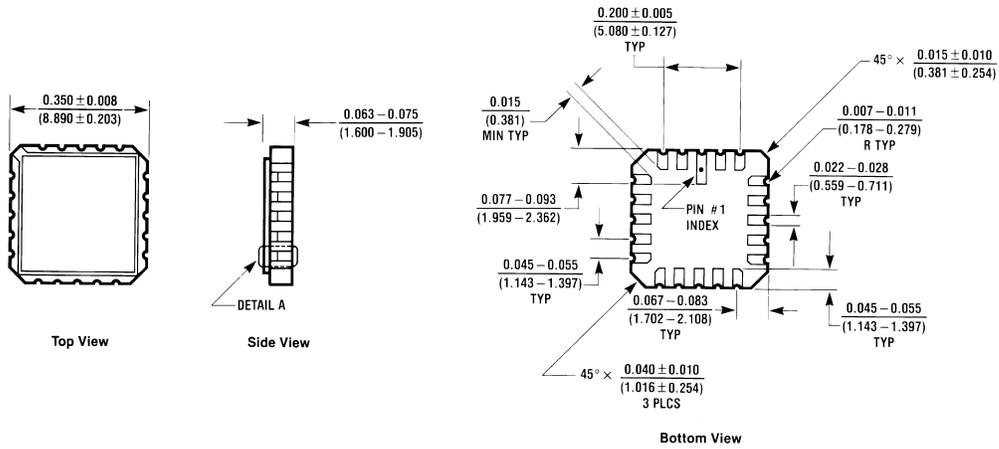
E20A (REV D)

20 Terminal Ceramic Leadless Chip Carrier (L)
NS Package Number E20A

0.785
[19.94] MAX

16   9

0.220−0.310
[5.59−7.87]

R 0.025
[0.64]

1   8

R 0.005−0.020
[0.13−0.51] TYP

0.037 ± 0.005
[0.94 ± 0.13] TYP

0.005
[0.13]
MIN TYP

0.055 ± 0.005
[1.40 ± 0.13] TYP

0.290−0.320
[7.37−8.13]

GLASS SEALANT

0.020−0.060
[0.51−1.52] TYP

0.200
[5.08]
MAX TYP

0.180
[4.57] MAX

0.150 MIN TYP
[3.81]

0.010 ± 0.002
[0.25 ± 0.05] TYP

0.125−0.200
[3.18−5.08] TYP

90° ± 4°
TYP

95° ± 5°
TYP

0.080
[2.03] MAX
BOTH ENDS

0.018 ± 0.003
[0.46 ± 0.08] TYP

0.310−0.410
[7.87−10.41]

J16A (REV L)

0.100 ± 0.010
[2.54 ± 0.25] TYP
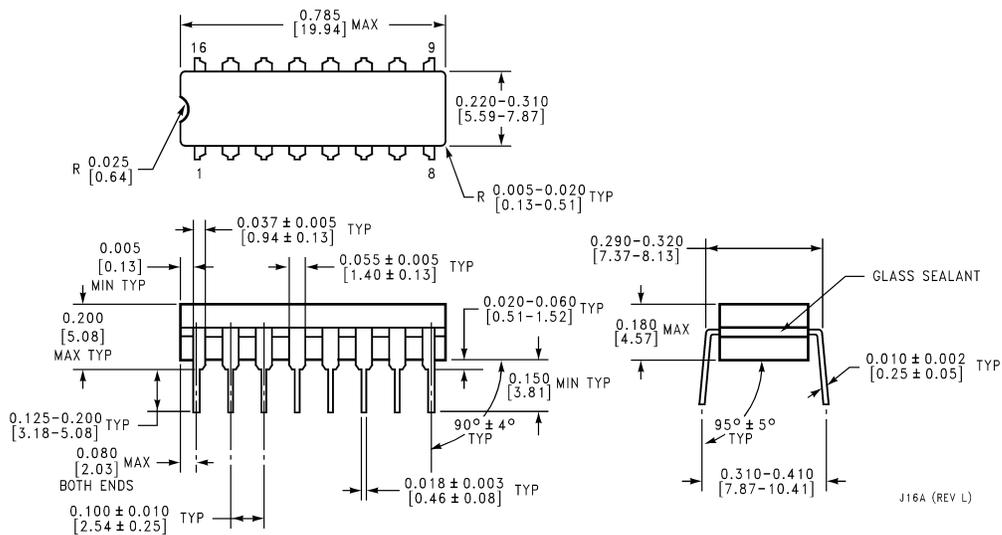
**16 Lead Ceramic Dual-In-Line Package (D)**
NS Package Number J16A

Physical Dimensions inches (millimeters) unless otherwise noted (Continued)

$$\frac{0.050 - 0.080}{(1.270 - 2.032)}$$

$$\frac{0.004 - 0.006}{(0.102 - 0.152)} \text{ TYP}$$

$$\frac{0.371 - 0.390}{(9.423 - 9.906)}$$

$$\frac{0.007 - 0.018}{(0.178 - 0.457)} \text{ TYP}$$

$$\frac{0.050 \pm 0.005}{(1.270 \pm 0.127)} \text{ TYP}$$

0.000 MIN TYP

$$\frac{0.250 - 0.370}{(6.350 - 9.398)}$$

16 15 14 13 12 11 10 9

$$\frac{0.300}{(7.620)} \text{ MAX GLASS}$$

$$\frac{0.245 - 0.275}{(6.223 - 6.985)}$$

2 3 4 5 6 7 8

DETAIL A

PIN NO. 1 IDENT

$$\frac{0.250 - 0.370}{(6.350 - 9.398)}$$

1

$$\frac{0.008 - 0.012}{(0.203 - 0.305)}$$

DETAIL A

$$\frac{0.026 - 0.040}{(0.660 - 1.016)} \text{ TYP}$$

$$\frac{0.015 - 0.019}{(0.381 - 0.482)} \text{ TYP}$$

W16A (REV H)
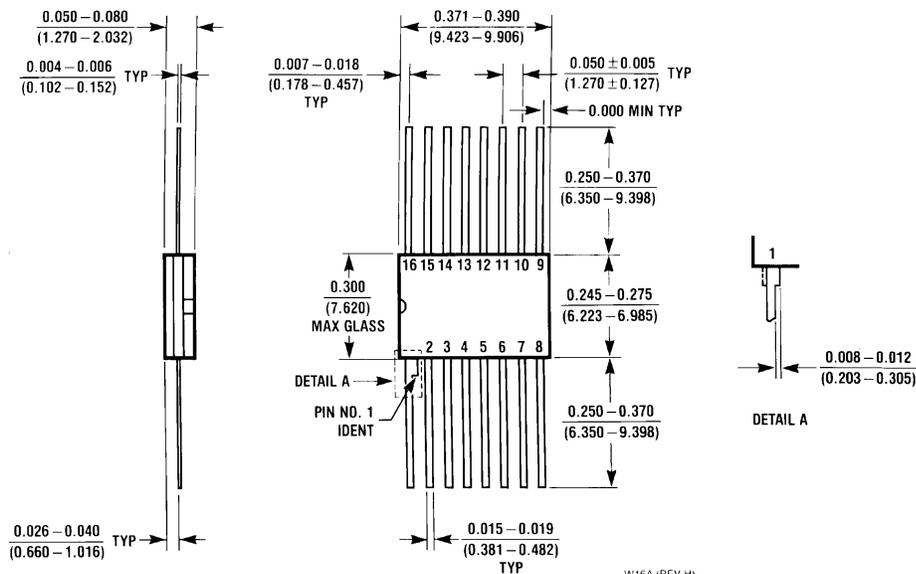
16 Lead Ceramic Flatpak (F)
NS Package Number W16A

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